

Attorney Docket No. 5649.1191
Application No.: 10/780,244
Filed: February 17, 2004
Page 5 of 9

RECEIVED
CENTRAL FAX CENTER
SEP 14 2005

16. (Currently Amended) The method of claim 15, wherein the thermally treating under the oxygen-enriched environment comprises supplying nitrogen as a carrier gas, ~~comprising~~ oxygen, and hydrogen at a temperature of between about 750~950°C and a ratio of oxygen/hydrogen of between about 0.5~1.3.

17. (Currently Amended) A method of forming ~~an integrated circuit device having a metal gate electrode comprising:~~

~~forming a stacked gate pattern onto a target substrate, the gate pattern comprising a metal-gate pattern on a target substrate with opposing first and second surfaces and at least one sidewall;~~

depositing a metal layer; and

oxidizing or nitrifying the deposited metal layer to form an oxidation barrier layer covering sidewalls of the metal-gate pattern.

~~and covering at least a portion of the at least one sidewall of the metal-gate pattern with an oxidation barrier layer substantially without covering a sidewall of an adjacent gate polysilicon layer with the oxidation barrier layer.~~

18. (Currently Amended) A method according to Claim 17, wherein forming a the ~~covering the at least one sidewall of the metal-gate pattern comprises;~~

forming a polysilicon gate layer and a metal gate layer on the target substrate; and

patterning the metal layer and the polysilicon layer to form a polysilicon-gate pattern and the metal-gate pattern.

~~-conformably covering substantially the entire outer surface of the sidewall(s) of the metal-gate pattern with the oxidation barrier layer.~~

19. (Currently Amended) A method according to Claim 18, wherein the metal gate layer comprises tungsten and the metal layer comprises aluminum, tantalum, titanium, hafnium, and gold. ~~gate pattern comprises a barrier-metal layer abutting the metal-gate pattern, and wherein the covering step is carried out to also substantially cover the sidewall(s) of the barrier-metal layer.~~

Attorney Docket No. 5649.1191
Application No.: 10/780,244
Filed: February 17, 2004
Page 6 of 9

20. (Currently Amended) A method according to Claim 18 [[19]], further comprising forming a barrier metal layer between the polysilicon gate layer and the metal gate layer, and further comprising forming a capping layer on the metal gate layer, wherein the gate pattern comprises a plurality of stacked pattern components with at least one respective sidewall including a capping pattern above the metal gate pattern and a gate polysilicon pattern below the metal gate pattern, and wherein the gate pattern is substantially devoid of the oxidation barrier layer proximate to the at least one sidewall of the respective gate polysilicon pattern and the capping pattern.

21. (Currently Amended) A method according to Claim 17 [[20]], wherein depositing a metal layer comprises depositing the metal layer using a chemical vapor deposition or an atomic layer deposition, further comprising thermally treating the gate pattern in an oxygen-enriched environment and inhibiting an oxide layer from forming between the metal barrier layer and the gate polysilicon layer based on the configuration of the oxidation barrier layer.

22. (Currently Amended) A method according to Claim 17 [[21]], wherein depositing a metal layer comprises depositing an aluminum layer, and wherein oxidizing or nitrifying the deposited metal layer comprises oxidizing the aluminum layer in an enriched oxygen environment, the integrated circuit device is a highly integrated device with reduced gate pattern size, and wherein the oxidation barrier layer has a thickness of between about 5-100Å.

23. (Currently Amended) ~~A method according to Claim 17~~

A method of forming an integrated circuit device having a metal gate electrode comprising:

forming a stacked gate pattern onto a target substrate, the gate pattern comprising a metal-gate pattern with opposing first and second surfaces and at least one sidewall; and
covering at least a portion of the at least one sidewall of the metal-gate pattern with an oxidation barrier layer substantially without covering a sidewall of an adjacent gate polysilicon

Attorney Docket No. 5649.1191
Application No.: 10/780,244
Filed: February 17, 2004
Page 7 of 9

layer with the oxidation barrier layer, wherein the oxidation barrier layer comprises aluminum oxide (Al_2O_3), and wherein the covering step comprises:

forming an aluminum layer using a CVD method by supplying methylpyrrolidine alane (MPA) as a source gas and argon (Ar) as a carrier gas at a temperature above ambient; and oxidizing the aluminum layer in an enriched oxygen environment to provide the oxidation barrier layer.

24. (Original) A method according to Claim 17, further comprising thermally treating the target substrate having the gate pattern with the oxidation barrier layer in an oxygen-enriched environment.

25. (Currently Amended) A method according to Claim 24, wherein the thermally treating under the oxygen-enriched environment comprises supplying nitrogen as a carrier gas, ~~comprising oxygen~~, and hydrogen at a temperature of between about 750~950°C and a ratio of oxygen/hydrogen of between about 0.5~1.3.

26-27. (Canceled)